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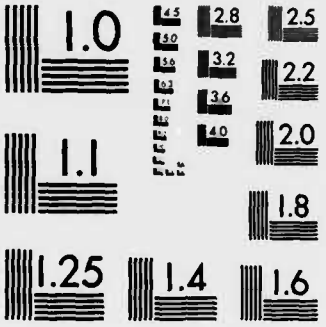

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The Naval Ordnance Station, Indian Head, MD, evaluated age-related performance deterioration of the Underseat Rocket Motor Mk 92 Mod 0. All motors fired successfully. It is recommended that the service life remain at 168 months from the date of propellant manufacture.

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20. ABSTRACT (Continued)

FOREWORD

This report describes the 1988 Quality Evaluation (QE) Program for the Underseat Rocket Motor (USRM) Mk 92 Mod 0. This evaluation was conducted by the Naval Ordnance Station, Indian Head, MD, for the Naval Air Systems Command, Washington, DC, under work assignment 00174/1/SEE-011.24.

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EXECUTIVE SUMMARY

1988 Underseat Rocket Motor Mark 92 Mod 0 Quality Evaluation

Purpose:

The purpose of this evaluation was to determine the safety and reliability of the Underseat Rocket Motor (USRM) Mk 92 Mod 0 and to determine the feasibility of a service life extension.

Test Procedure:

Eight USRMs were visually inspected, radiographically examined, temperature conditioned to either −40 or 160 °F (−40 or 71 °C), and static-fired to measure ballistic performance. After static-firing, the motors were inspected and evaluated for marginality of success.

Results:

The prefiring visual inspection revealed several external defects—broken lockwires, missing nozzle caps, scratched paint, and torn labeling. Radiographic examinations showed that all motors were correctly assembled. Ballistic performance at temperatures of −40 and 160 °F (−40 and 71 °C) was within production specifications for all motors tested. No defects were detected by postfiring marginality of success inspections.

Conclusions:

Based on the results of this quality evaluation, it was concluded that:

(1) The minimum predicted life is 168 months.

(2) The most probable life is 180 months.

(3) The current service life should be maintained at 168 months from the date of propellant manufacture because of the inconsistent trends for initiation pressure.

(4) No major problem areas were identified.

(5) A quality evaluation of fleet-returned units should be conducted during FY 91.

(6) No problems requiring rapid action were identified.

(7) The performance of the Underseat Rocket Motor Mark 92 Mod 0 is exhibiting only minor variations in performance with age and all units are predicted to continue to perform at acceptable levels through 168 months from the date of propellant manufacture. The high variability of the initiation pressure in units which use Duralac on the shear pin as a corrosion inhibitor will no longer affect the fleet inventory since all Duralac units were removed from the fleet in April 1984.

Recommendations:

Based on the results of this evaluation, it is recommended that the service life of the USRM Mk 92 Mod 0 be maintained at 168 months from the date of propellant manufacture.

CONTENTS

FIGURES

TABLES

INTRODUCTION

Design and Operation:

The Underseat Rocket Motor (USRM) Mk 92 Mod 0 (Figure 1) is used in the Martin Baker-produced aircrew escape system installed in the Navy F-4 and RF-4 series aircraft. The rocket motor provides the thrust necessary to propel the man-seat combination after the ejection gun operation to a safe parachute deployment altitude, even in zero-speed, zero-altitude ejections. This system is required to operate over a temperature range of −40 to 160 °F (−40 to 71 °C). The specification limits are as follows:

Parameter	Minimum	Maximum
Maximum thrust [lbf (N)]	3,700 (16,458)	6,900 (30,693)
Impulse [lbf-s (N-s)]	1,160 (5,160)	1,390 (6,183)
Action time (ms)	220	475
Ignition delay (ms)	—	25
Initiation pressure [psig (MPa)]	400 (2.758)	600 (4.137)

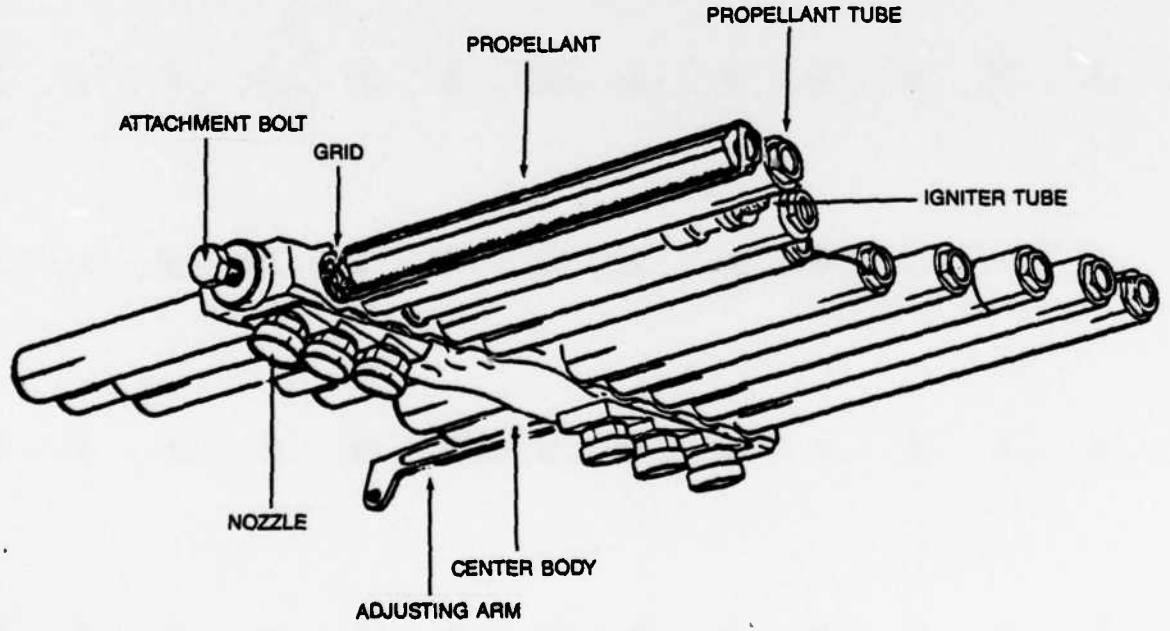


FIGURE 1. ROCKET MOTOR MARK 92 MOD 0

The major components of the motor are 16 steel propellant tubes of varying lengths, a center body with 6 nozzles, and the hardware necessary for attachment to the ejection seat. The center body is machined internally to form a plenum chamber to receive hot gasses from the propellant tubes and direct them to the nozzles. Each propellant tube contains a cylindrical, extruded, double-base propellant grain with three equally spaced external ribs for support.

Background:

This was the seventh quality evaluation (QE) performed on the Mk 92 Mod 0 USRM. Previous evaluations were performed in 1977, 1979, 1980, 1982, 1984, and 1986. In this analysis only Mk 92 data were used, whereas in previous analyses the Mk 51 data were included. The Mk 51 Mod 0 USRM is identical to the Mk 92 Mod 0 in all respects except for the firing mechanism. The Mk 92 uses a gas-actuated, gas-powered firing pin, whereas the Mk 51 uses a mechanically actuated, spring-powered firing pin. Units were conditioned at −40 and 160 °F (−40 and 71 °C). Tests performed in 1984 and 1986 also conditioned units at 70 °F (21 °C).

TEST PROCEDURES

A sample of eight Mk 92 Mod 0 USRMs were visually inspected and radiographically examined in accordance with MIL-A-85097B to determine if any defects were present. These units were then temperature conditioned for a minimum of 12 hours and static-fired to measure their performance. After firing, the units were subjected to an external visual inspection and a marginality of success (MOS) evaluation. Lot number, serial number, age and firing temperature are presented in Table I.

TABLE I. TEST SAMPLE

Lot No.	Test motor serial No.	Age fired (mo)	Conditioning temperature [°F (°C)]
R-108	13167	157	−40 (−40)
R-108	13206	157	−40 (−40)
R-108	13218	157	160 (71)
R-108	13376	157	160 (71)
R-118	14080	146	160 (71)
R-118	14107	146	−40 (−40)
R-118	14284	146	160 (71)
R-118	14362	146	−40 (−40)

TEST RESULTS

Visual Inspection:

Visual inspection of the rocket motors determined that all eight of the units had been installed in aircraft. The units exhibited minor defects such as scratched paint, broken lockwires, missing mounting bolts, missing initiator caps, missing nozzle caps, and torn labeling. None of the defects would have affected the operation of the rocket motor.

Radiographic:

The radiographic examination of all the units revealed no internal defects. All motor components were present and had been correctly installed.

Ballistic:

All eight rocket motors met the ballistic requirements of MIL-A-85097/8B. The ballistic results for this and past QE programs are presented in Appendix A. The thrust-time plots from the static-firings are presented in Appendix B.

Postfiring Inspection:

A postfiring inspection and MOS evaluation was conducted on all eight static-fired rocket motors. The cartridges and all propellant tubes were removed from each motor. The igniter cartridge primer penetration minimum of 0.015 inch (0.038 cm) was exceeded in all cases. No defects or evidence of marginal performance was found on any motors.

DATA ANALYSIS

Confidence and tolerance limits:

Two major sets of statistics were computed. The first set is based on sample statistics and it applies to units covering the entire age span of the population. We used an effective degrees of freedom and total standard deviation where there were significant differences between lots or programs. Confidence and tolerance limits based on sample statistics are given in Table II. The second major set of statistics is based on aging trends; it gives estimated performance values at 228 and 252 months. These statistics were computed from the aging trends using n, the total number of observations used in performing the regression analysis; n', the effective number of observations at the specified age; y, the estimated mean at this point, and s_e, the standard error for the regression. Limits based on the aging trends are given in Table III. Ninety percent confidence limits were computed on the population at the 90% confidence level.

At −40 °F the lower confidence limits for initiation pressure based on the combined quality evaluations and at 228 and 252 months of age exceeded the upper specification limit. This means that we are 95% confident that more than 50% of the propellant will fail. Further, at 70 and 160 °F, the means for initiation pressure ar 228 and 252 months of age exceeded the upper specification limit, also indicating that more than 50% of the population will fail.

The only tolerance limits to exceed the upper limits were those for initiation pressure.

Estimated Percentage Defective Statistics:

The estimated percentage defective (EPD) statistic gives the percentage of units in the population expected to fail a given specification limit. The $P_{.05}$ and $P_{.95}$ values represent the lower and upper confidence limits respectively on the true percentage defective. All EPD statistics for cases where $P_{.95}$ exceeded 3.0 are given in Table IV. The EPD statistics indicated an extremely high failure rate (up to 95.7%) for initiation pressure.

Reliability:

The reliability statistics give an estimate of the ability of an item to perform successfully with respect to specific performance requirements. We considered two types of reliability: catastrophic and functional. Catastrophic reliability indicates the ability of the unit to complete the firing sequence, while functional reliability indicates the ability of the unit to perform within specified limits.

No catastrophic failures have occurred for any of the units tested; the observed catastrophic reliability is 1.000, while the estimated reliability at the lower 90% confidence level is 0.978 based on 105 units tested.

The functional reliability was computed with and without the ignition pressure data. The observed functional reliability including these data is 0.638, while the estimated reliability at the lower 90% confidence level is 0.575. The observed functional reliability excluding the ignition pressure data is 1.000, while the estimated reliability at the lower 90% confidence level is 0.978. Since the estimated reliability is quite low when the ignition pressure data are included, we also computed the estimated reliability at the upper 90% confidence level to be 0.702. This means that the true reliability is no greater than 0.702.

TABLE II. CONFIDENCE AND TOLERANCE LIMITS BASED ON SAMPLE STATISTICS[1]

Paramter	Sample statistics				90% Confidence limits on population mean		Tolerance limits on individual values (γ=0.90, P=0.99	
	n	$\bar{y}$	s	df	Lower	Upper	Lower	Upper
1988 Quality Evaluation								
-40 °F (-40 °C)								
Maximum thrust (lbf)	4	4604.5	58.81	3	4535.3	4673.7	4225.8	4983.2
Impulse (lbf-s)	4	1265.0	14.26	3	1248.2	1281.8	1173.2	1356.8
Action time (ms)	4	308.8	8.18	3	299.2	318.4	256.1	361.5
Ignition delay (ms)	4	4.2	0.50	3	3.6	4.8	—	6.9
Initiation pressure (psig)	4	587.2	11.56	3	573.6	600.8[2]	512.8	661.6[2]
160 °F (71 °C)								
Maximum thrust (lbf)	4	5619.8	86.42	3	5518.1	5721.5	5063.3	6176.3
Impulse (lbf-s)	4	1302.5	14.15	3	1285.9	1319.1	1211.4	1393.6
Action time (ms)	4	258.2	3.50	3	254.1	262.3	235.7	280.7
Ignition delay (ms)	4	4.5	0.58	3	3.8	5.2	—	7.7
Initiation pressure (psig)	4	507.5	11.96	3	493.4	521.6	430.5	584.5
Combined Quality Evaluations								
-40 °F (-40 °C)								
Maximum thrust (lbf)	48	4583.0	87.21	27[3]	4561.6	4604.4	4305.9	4860.1
Impulse (lbf-s)	48	1256.1	12.06	19[3]	1253.1	1259.1	1216.0	1296.2
Action time (ms)	48	311.5	13.24	34[3]	308.3	314.7	270.5	352.5
Ignition delay (ms)	48	3.5	1.44	10[3]	3.1	3.9	—	6.3
Initiation pressure (psig)	39	672.3[2]	126.42	16[3]	637.0[2]	707.6[2]	240.1[2]	1104.5[2]
70 °F (21 °C)								
Maximum thrust (lbf)	9	5107.8	74.72	8	5061.5	5154.1	4801.6	5414.0
Impulse (lbf-s)	9	1285.1	14.17	8	1276.3	1293.9	1227.0	1343.2
Action time (ms)	9	273.7	3.53	8	271.5	275.9	259.2	288.2
Ignition delay (ms)	9	2.9	0.78	8	2.4	3.4	—	5.7
Initiation pressure (psig)	9	567.8	82.22	8	516.3	618.8[2]	230.9[2]	904.7[2]
160 °F (71 °C)								
Maximum thrust (lbf)	48	5557.8	134.22	28[3]	5524.8	5590.8	5133.1	5982.5
Impulse (lbf-s)	48	1291.4	11.16	47	1288.7	1294.1	1257.8	1325.0
Action time (ms)	48	257.2	2.97	47	256.5	257.9	248.3	266.1
Ignition delay (ms)	48	3.7	1.19	11[3]	3.4	4.0	—	7.8
Initiation pressure (psig)	37	565.9	60.75	36	549.0	582.8	378.0[2]	753.8[2]

[1]All measurements are given only in the original units used.
[2]Exceeds specification limit.
[3]Effective degrees of freedom used because of significant differences between quality evaluations.

TABLE III. CONFIDENCE AND TOLERANCE LIMITS BASED ON AGING TRENDS[1]

Paramter	Estimated statistics from regression				90% Confidence limits on population mean		Tolerance limits on individual values (γ=0.90, P=0.99)	
	n	n'	$\hat{y}$	s_e	Lower	Upper	Lower	Upper
Age = 228 Months								
-40 °F (-40 °C)								
Maximum thrust (lbf)	51	6	4537.5	88.98	4476.8	4598.2	4253.8	4821.2
Impulse (lbf-s)	51	6	1253.8	11.75	1245.8	1261.8	1216.3	1291.3
Action time (ms)	50	6	315.5	8.77	309.5	321.5	287.5	343.5
Ignition delay (ms)	51	6	4.6	1.26	3.7	5.5	—	8.4
Initiation pressure (psig)	42	5	789.0[2]	112.38	708.0[2]	870.0[2]	420.3	1157.7[2]
70 °F (21 °C)								
Maximum thrust (lbf)	9	1	5095.9	79.72	4957.4	5234.4	4679.0	5512.8
Impulse (lbf-s)	9	1	1268.8	13.31	1245.7	1291.9	1199.2	1632.7
Action time (ms)	9	1	269.8	3.36	264.0	275.6	252.2	287.4
Ignition delay (ms)	9	1	4.1	0.63	3.0	5.2	—	6.9
Initiation pressure (psig)	9	1	692.9[2]	68.28	574.3	811.5[2]	335.9[2]	1049.9[2]
160 °F (71 °C)								
Maximum thrust (lbf)	51	6	5578.2	131.72	5488.3	5668.1	5158.2	5998.2
Impulse (lbf-s)	51	6	1293.7	11.04	1286.2	1301.2	1258.5	1328.9
Action time (ms)	51	6	255.1	2.82	253.2	257.0	246.1	264.1
Ignition delay (ms)	51	6	5.0	1.05	4.3	5.7	—	8.1
Initiation pressure (psig)	40	5	624.3[2]	56.16	583.4	665.2[2]	439.2	809.4[2]
Age = 252 Months[3]								
-40 °F (-40 °C)								
Maximum thrust (lbf)	51	4	4527.4	88.98	4455.5	4599.3	4235.7	4819.1
Impulse (lbf-s)	51	4	1253.2	11.75	1243.7	1262.7	1214.7	1291.7
Action time (ms)	50	4	316.7	8.77	309.6	323.8	287.9	345.5
Ignition delay (ms)	51	4	4.8	1.26	3.8	5.8	—	8.7
Initiation pressure (psig)	42	4	814.1[2]	112.38	718.8[2]	909.4[2]	439.3	1188.9[2]
160 °F (71 °C)								
Maximum thrust (lbf)	51	4	5581.3	131.72	5474.7	5687.9	5149.4	6013.2
Impulse (lbf-s)	51	4	1294.2	11.04	1285.3	1303.1	1258.0	1330.4
Action time (ms)	51	4	254.7	2.82	252.4	257.0	245.5	263.9
Ignition delay (ms)	51	4	5.2	1.05	4.4	6.0	—	8.4
Initiation pressure (psig)	40	4	637.1[2]	56.17	588.9	685.3[2]	448.9	825.3[2]

[1]All measurements are given only in the original units used.
[2]Exceeds specification limit.
[3]No statistics computed at 70 °F because n' was less than 1.

TABLE IV. ESTIMATED PERCENTAGE DEFECTIVE STATISTICS FOR INITIATION PRESSURE

Temperature [°F (°C)]	Specification limit	$P_{.05}$	EPD	$P_{.95}$
		1988 Quality Evaluation		
−40 (−40)	Upper	1.6	15.7	51.6
		Combined Quality Evaluations		
−40 (−40)	Upper	44.9	71.2	84.0
−40 (−40)	Lower	0.2	1.8	8.2
70 (21)	Upper	16.3	35.4	59.0
70 (21)	Lower	0.1	2.6	17.3
160 (71)	Upper	19.8	29.0	39.6
160 (71)	Lower	0.0	0.3	1.7
		Total Age = 228 Months		
−40 (−40)	Upper	66.8	94.0	99.8
−40 (−40)	Lower	0.0	0.0	9.6
160 (71)	Upper	35.5	65.6	88.2
160 (71)	Lower	0.0	0.0	6.1
		Total Age = 252 Months		
−40 (−41)	Upper	64.2	95.7	100.0
−40 (−41)	Lower	0.0	0.1	13.7
160 (71)	Upper	37.8	72.7	93.8
160 (71)	Lower	0.0	0.0	9.7

Aging Trends:

The aging trends were derived from the analysis of QE and lot acceptance test (LAT) data. Individual QE data and LAT means are plotted with respect to total age in Appendix C. The aging equations were computed using the least squares method and the tolerance limits were computed to include at least 90% of the population at the 90% confidence level.

Initiation pressure and ignition delay trends are increasing, while all other trends indicate little or no aging effect. The aging trend equations for initiation pressure at −40, 70, and 160 °F (−40, 21, and 71 °C) cross the upper specification limit at approximately 45, 150, and 180 months of age, respectively. This means that beginning at about these ages, more than 50% of the population will fail. The upper tolerance limits on the aging trend equations for initiation pressure exceed the upper specification limit at all ages, indicating that some failures can be expected regardless of age.

CONCLUSIONS

Based on the results of this quality evaluation, it was concluded that:

(1) The Underseat Rocket Motor Mk 92 Mod 0 will perform satisfactorily over a temperature range of −40 to 160 °F (−40 to 71 °C) throughout the current service life.

(2) The estimated percentage defective statistics indicate an extremely high failure rate (up to 95.7%) for initiation pressure with regard to the upper specification limit.

(3) Trends for initiation pressure and ignition delay are increasing, while all other trends indicate little or no aging effect.

(4) The high variability of the initiation pressure in units which use Duralac on the shear pin as a corrosion inhibitor will no longer affect the fleet inventory since all Duralac units were removed from the fleet in April 1984.

RECOMMENDATION

Based on the results of this evaluation, it is recommended that the service life of the Underseat Rocket Motor Mk 92 Mod 0 be maintained at 168 months from the date of propellant manufacture because of the inconsistent trends for initiation pressure.

Appendix A

INDIVIDUAL BALLISTIC VALUES[1]

[1]All measurements are given only in the units originally used.

TABLE A-1. INDIVIDUAL BALLISTIC VALUES

Lot No.	Age (mo)	Maximum thrust (lbf)	Impulse (lbf-s)	Action time (ms)	Ignition delay (ms)	Initiation pressure (psig)
			−40 °F (−40 °C)			
			1977 Quality Evaluation			
R-7	114	4452	1255	333	2	676[1]
R-19	109	4677	1271	303	5	591
R-25	107	4631	1259	310	2	568
R-27	106	4737	1259	300	2	591
R-38	94	4620	1260	308	2	693[1]
R-59	77	4569	1253	307	2	857[1]
R-68	67	4607	1251	304	2	562
R-80	57	4619	1255	305	2	534
R-83	56	4543	1248	305	2	591
R-83	56	4534	1248	307	2	602[1]
			1979 Quality Evaluation			
R-21	129	4442	1236	341	4	—
R-22	129	4544	1252	320	4	—
R-22	129	4562	1250	316	6	—
R-23	129	4447	1240	378	5	—
R-24	129	4637	1257	306	4	—
R-25	128	4672	1259	302	5	—
R-25	128	4466	1251	325	5	—
R-26	128	4533	1248	323	5	—
R-40	113	4497	1256	315	4	—
			1980 Quality Evaluation			
R-25	143	4798	1270	294	5	765[1]
R-26	143	4676	1269	304	5	803[1]
R-27	142	4602	1263	304	5	776[1]
R-28	142	4669	1268	306	5	646[1]
R-38	130	4647	1278	309	4	793[1]
R-60	116	4646	1268	306	6	766[1]
R-83	92	4506	1261	311	5	642[1]
R-116	52	4713	1261	297	5	565
			1982 Quality Evaluation			
R-38	149	4496	1245	314	1.5	730[1]
R-38	149	4511	1242	314	2.0	972[1]
R-40	147	4552	1253	316	2.7	706[1]
R-43	146	4535	1250	312	3.9	871[1]
R-59	132	4470	1236	310	1.2	858[1]
R-68	122	4496	1239	309	1.5	778[1]
R-80	112	4523	1247	306	2.0	979[1]
R-116	71	4514	1236	305	2.3	586
			1984 Quality Evaluation			
R-31	187	4612	1258	310	3	649[1]
R-83	137	4513	1250	312	3	666[1]
R-108	108	4554	1270	314	3	517
R-108	108	4569	1272	316	3	512

See footnotes at end of table.

TABLE A-1. CONTD

Lot No.	Age (mo)	Maximum thrust (lbf)	Impulse (lbf-s)	Action time (ms)	Ignition delay (ms)	Initiation pressure (psig)
			1986 Quality Evaluation			
R-38	198	4563	1252	318	4	646[1]
R-118	120	4588	1243	306	3	636[1]
R-118	120	4543	1248	309	4	575
MBA80K001-002	64	4724	1271	304	4	575
MBA80K001-002	64	4754	1278	302	3	595
			1988 Quality Evaluation			
R-108	157	4556	1272	316	4	595
R-108	157	4556	1281	315	5	575
R-118	146	4631	1258	305	4	599
R-118	146	4675	1249	299	4	580
			70 °F (21 °C)			
			1984 Quality Evaluation			
R-68	148	5029	1278	276	3	707[1]
R-80	138	5077	1285	274	2	530
R-108	108	5088	1296	278	3	475
R-108	108	5117	1296	276	3	488
			1986 Quality Evaluation			
R-26	211	5215	1282	266	4	699[1]
R-118	120	5009	1267	276	3	549
R-118	120	5061	1262	272	4	549
MBA80K001-002	64	5164	1301	273	2	549
MBA80K001-002	64	5210	1299	272	2	564
			160 °F (71 °C)			
			1977 Quality Evaluation			
R-9	112	5362	1292	258	3	576
R-21	108	5459	1286	254	3	610[1]
R-24	108	5622	1294	254	3	565
R-27	106	5536	1287	253	3	604[1]
R-36	103	5524	1292	256	3	666[1]
R-46	85	5411	1280	254	3	576
R-68	67	5517	1284	258	2	542
R-80	57	5362	1280	258	3	519
R-80	57	5506	1289	260	3	502
R-83	56	5265	1275	258	3	536
			1979 Quality Evaluation			
R-15	131	5386	1289	258	5	—
R-22	129	5450	1291	258	4	—
R-23	129	5455	1294	258	4	—
R-23	129	5720	1294	254	5	—
R-24	129	5526	1296	258	5	—
R-24	129	5570	1295	255	4	—
R-25	128	5503	1291	255	5	—
R-31	127	5455	1277	254	4	—
R-80	78	5399	1285	263	4	—

See footnotes at end of table.

TABLE A-1. CONTD

Lot No.	Age (mo)	Maximum thrust (lbf)	Impulse (lbf-s)	Action time (ms)	Ignition delay (ms)	Initiation pressure (psig)
			1980 Quality Evaluation			
R-24	144	5834	1308	254	6	612[1]
R-25	143	5639	1300	254	4	976[1,2]
R-27	142	5739	1295	254	5	607[1]
R-27	142	5710	1302	254	6	662[1]
R-28	142	5632	1302	255	5	616[1]
R-36	139	5746	1305	253	6	621[1]
R-68	103	5584	1291	261	5	849[1,2]
R-83	92	5575	1288	262	5	537
			1982 Quality Evaluation			
R-38	149	5546	1280	256	3.5	584
R-40	147	5562	1297	256	1.5	603[1]
R-43	146	5530	1288	256	2.5	694[1]
R-48	140	5533	1287	257	2.2	570
R-68	122	5449	1275	258	3.2	591
R-80	112	5472	1278	261	3.1	530
R-83	111	5392	1272	265	1.5	562
R-108	82	5941	1292	258	3.2	561
			1984 Quality Evaluation			
R-38	175	5617	1304	256	3	523
R-80	138	5474	1290	261	3	662[1]
R-83	137	5546	1290	260	3	438
R-108	108	5672	1309	261	4	469
			1986 Quality Evaluation			
R-31	210	5546	1280	253	5	680[1]
R-118	120	5547	1277	256	4	508
R-118	120	5545	1273	256	4	529
MBA80K001-002	64	5725	1310	258	2	515
MBA80K001-002	64	5710	1314	260	3	539
			1988 Quality Evaluation			
R-108	157	5686	1315	260	5	521
R-108	157	5674	1314	262	4	514
R-118	146	5622	1287	254	4	496
R-118	146	5497	1294	257	5	499

[1]Exceeds specification limit.
[2]Statistical outlier.

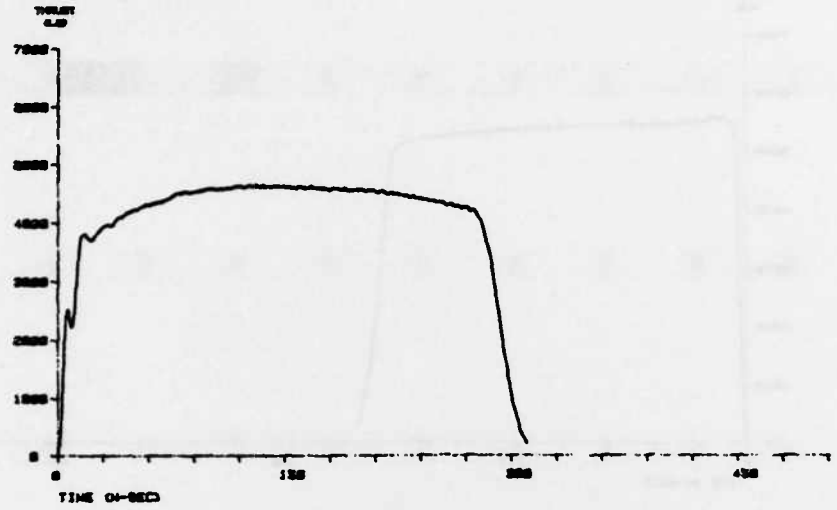
Appendix B

THRUST-TIME PLOTS[1]

[1]All measurements are given only in the units originally used.

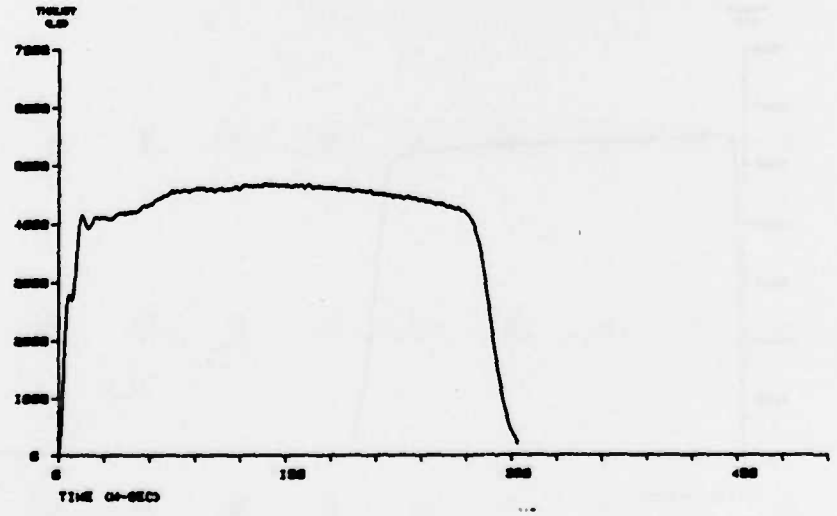
7170
MK 92 MOD 0 S/N 14362 -40F

IGNITION DELAY	4.2	(M-SEC)	0.0	TO	25.0
MAXIMUM THRUST	4831.1	(LBF)	3788.0	TO	5088.0
ACTION TIME	364.0	(M-SEC)	228.0	TO	475.0
IMPULSE	1257.0	(LBF-SEC)	1168.0	TO	1368.0



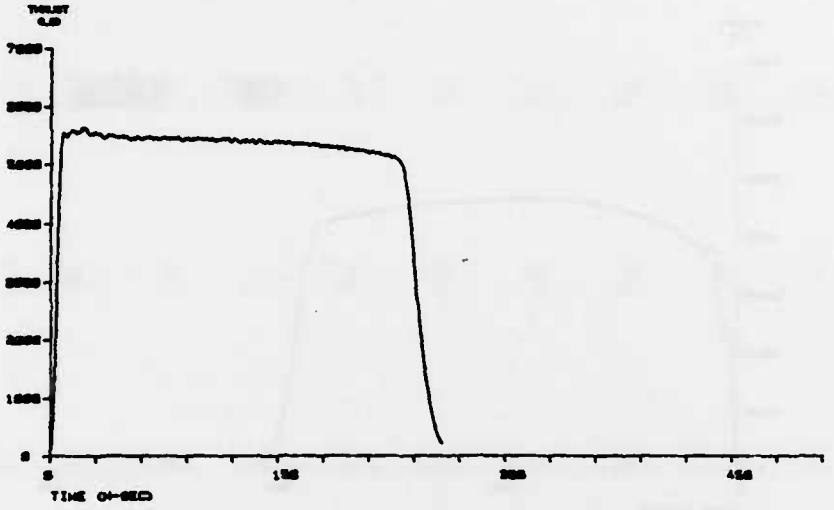
7171
MK 92 MOD 0 S/N 14107 -40F

IGNITION DELAY	3.0	(M-SEC)	0.0	TO	25.0
MAXIMUM THRUST	4876.1	(LBF)	3788.0	TO	5088.0
ACTION TIME	356.2	(M-SEC)	228.0	TO	475.0
IMPULSE	1248.9	(LBF-SEC)	1168.0	TO	1368.0



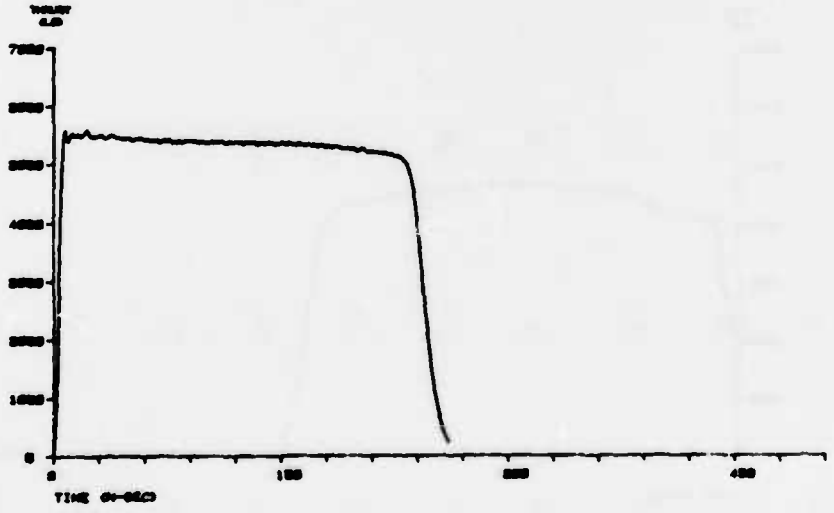
7172
MK 82 MOD 8 S/N 14088 160F

IGNITION DELAY	4.2	(M-SEC)	0.0	TO	25.0
MAXIMUM THRUST	5621.0	(LBF)	3750.0	TO	5000.0
ACTION TIME	254.0	(M-SEC)	225.0	TO	475.0
IMPULSE	1287.2	(LBF-SEC)	1150.0	TO	1300.0



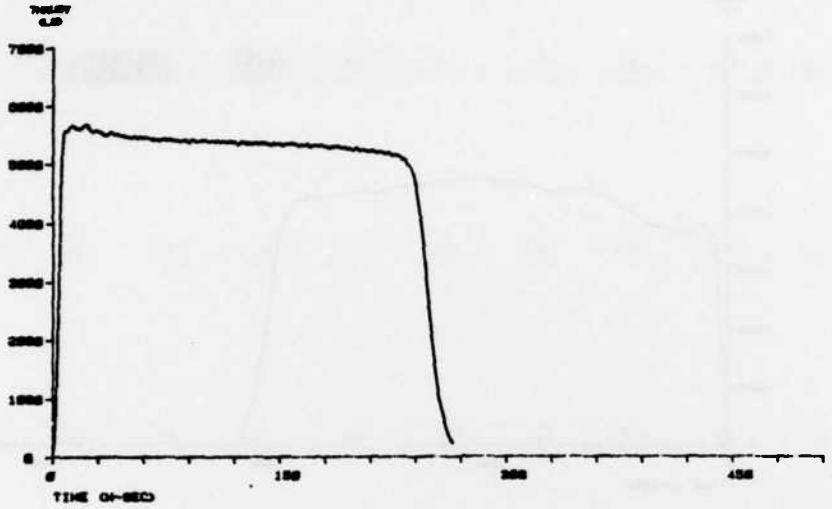
7173
MK 82 MOD 8 S/N 14284 160F

IGNITION DELAY	4.0	(M-SEC)	0.0	TO	25.0
MAXIMUM THRUST	5617.0	(LBF)	3750.0	TO	5000.0
ACTION TIME	250.0	(M-SEC)	225.0	TO	475.0
IMPULSE	1300.0	(LBF-SEC)	1150.0	TO	1300.0



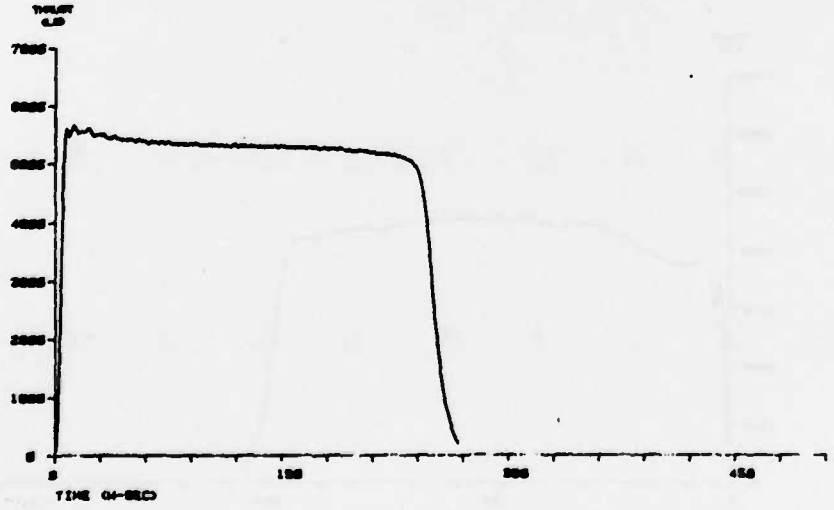
7174
MK 92 MOD 0 S/N 13378 160F

IGNITION DELAY	4.0	(M-SEC)	0.0 TO	25.0
MAXIMUM THRUST	5868.3	(LBF)	5720.0 TO	6000.0
ACTION TIME	298.0	(M-SEC)	225.0 TO	475.0
IMPULSE	1314.6	(LBF-SEC)	1168.0 TO	1368.0



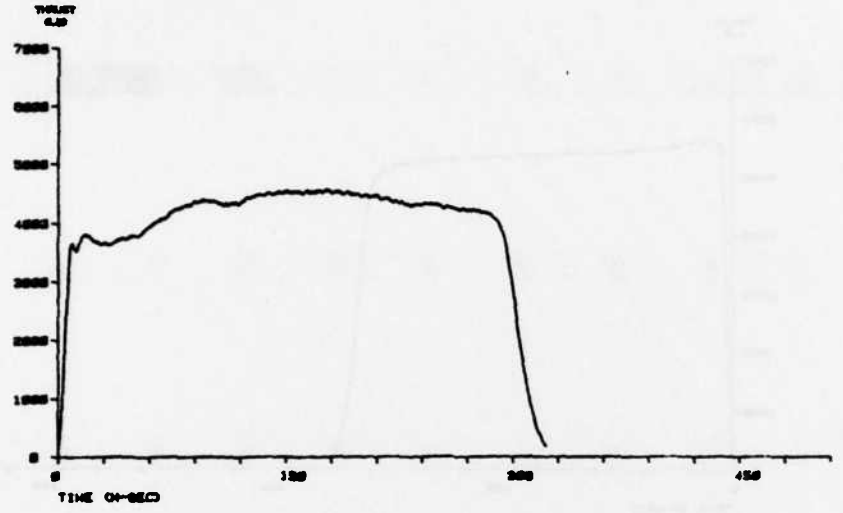
7175
MK 92 MOD 0 S/N 13218 160F

IGNITION DELAY	4.2	(M-SEC)	0.0 TO	25.0
MAXIMUM THRUST	5874.1	(LBF)	5720.0 TO	6000.0
ACTION TIME	291.0	(M-SEC)	225.0 TO	475.0
IMPULSE	1314.5	(LBF-SEC)	1168.0 TO	1368.0



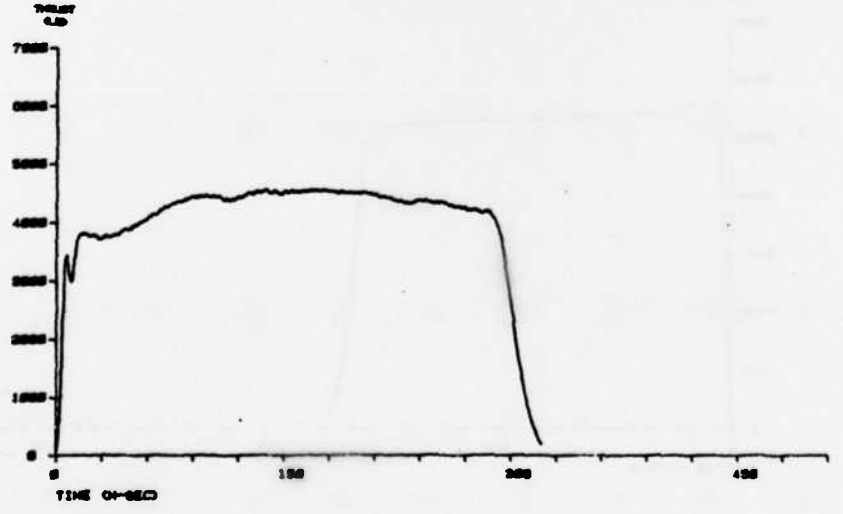
7178
MK 92 MOD 0 S/N 13167 -40F

IGNITION DELAY	4.4	CM-SEC	5.0 TO	23.0
MAXIMUM THRUST	4868.0	CLBF	3788.0 TO	6068.0
ACTION TIME	318.4	CM-SEC	228.0 TO	475.0
IMPULSE	1272.0	CLBF-SEC	1158.0 TO	1308.0



7177
MK 92 MOD 0 S/N 13206 -40F

IGNITION DELAY	4.0	CM-SEC	5.0 TO	23.0
MAXIMUM THRUST	4864.1	CLBF	3788.0 TO	6068.0
ACTION TIME	318.2	CM-SEC	228.0 TO	475.0
IMPULSE	1281.0	CLBF-SEC	1163.0 TO	1308.0



Appendix C

AGING TREND PLOTS

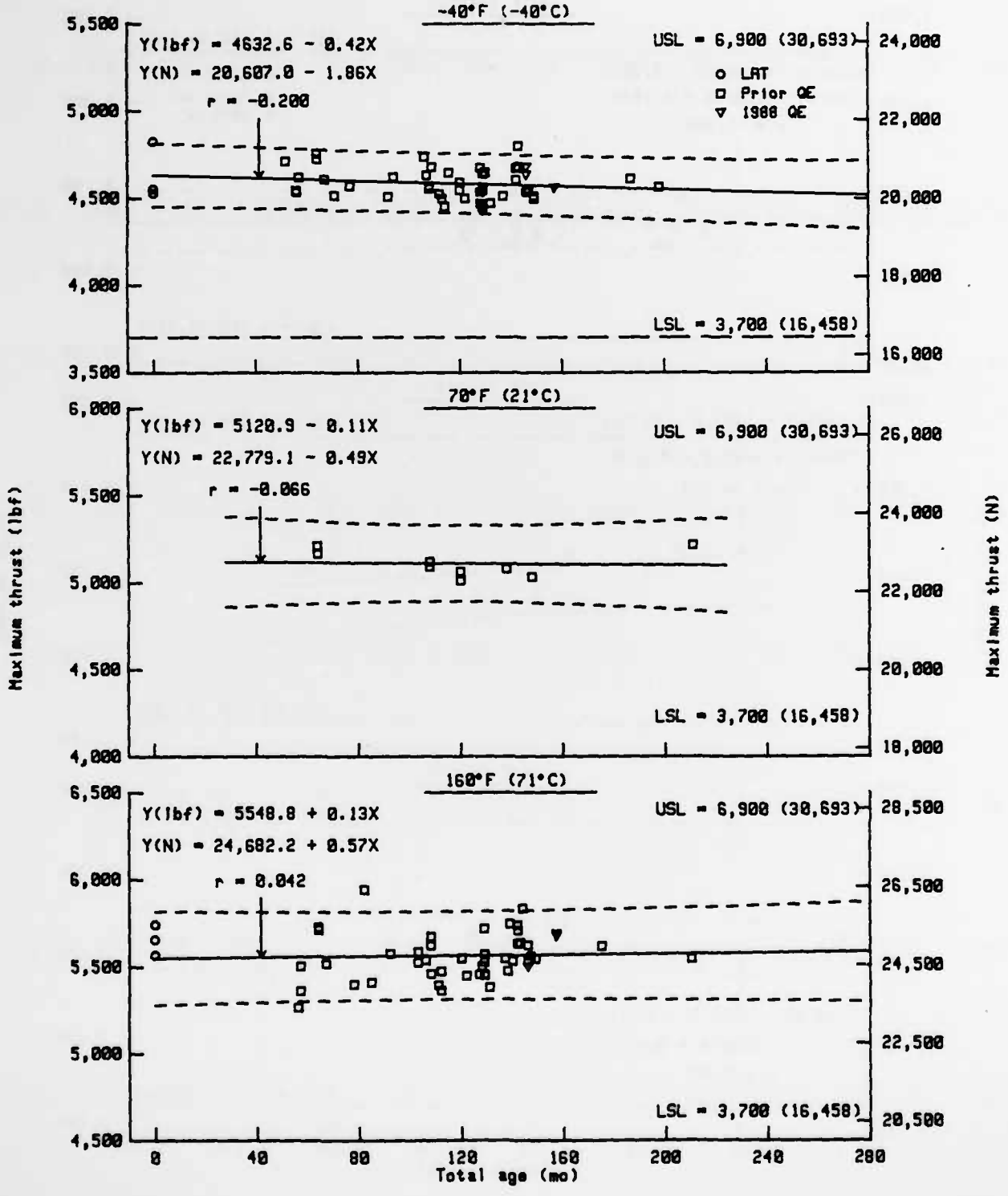


FIGURE C-1. MAXIMUM THRUST VERSUS TOTAL AGE

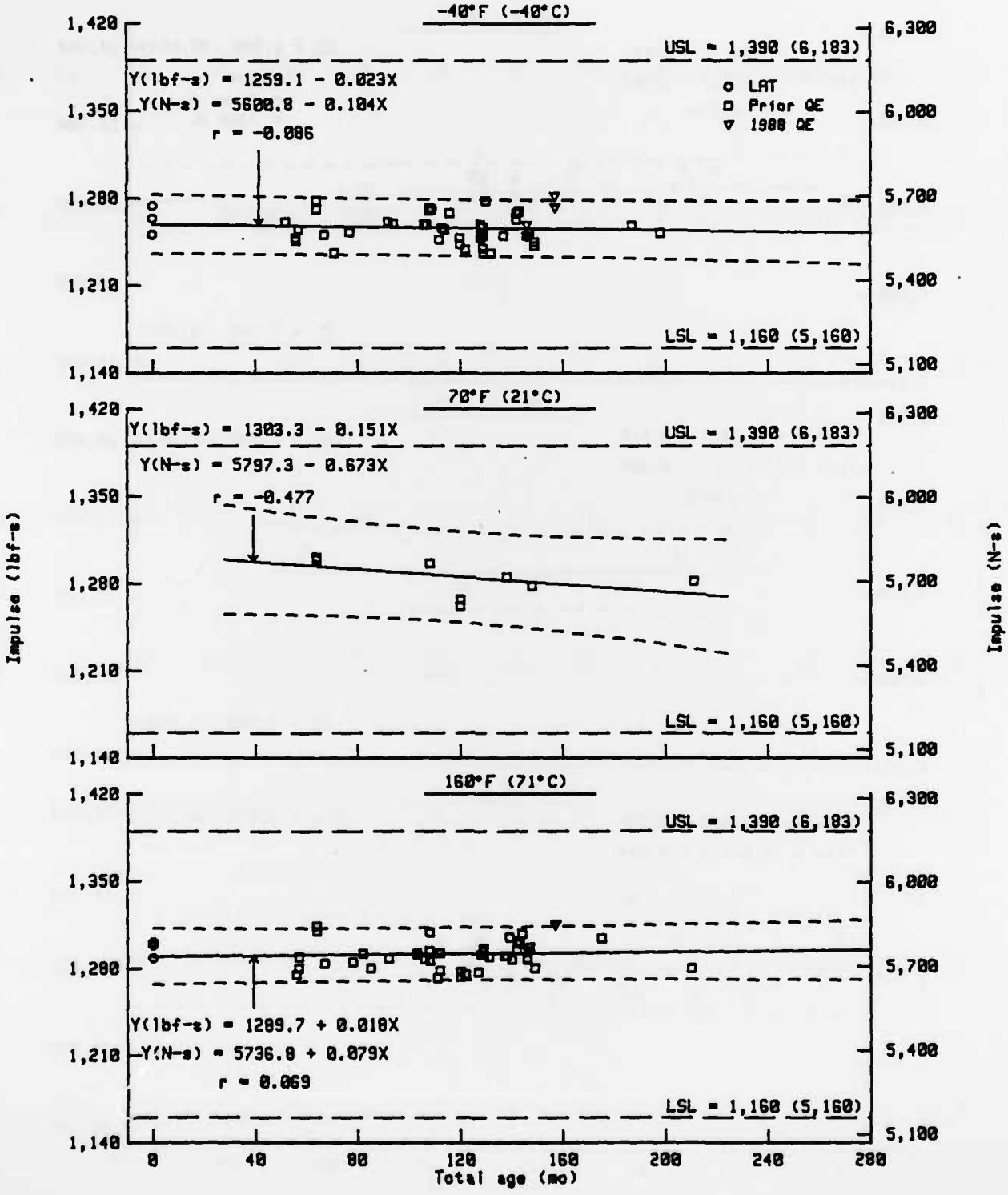
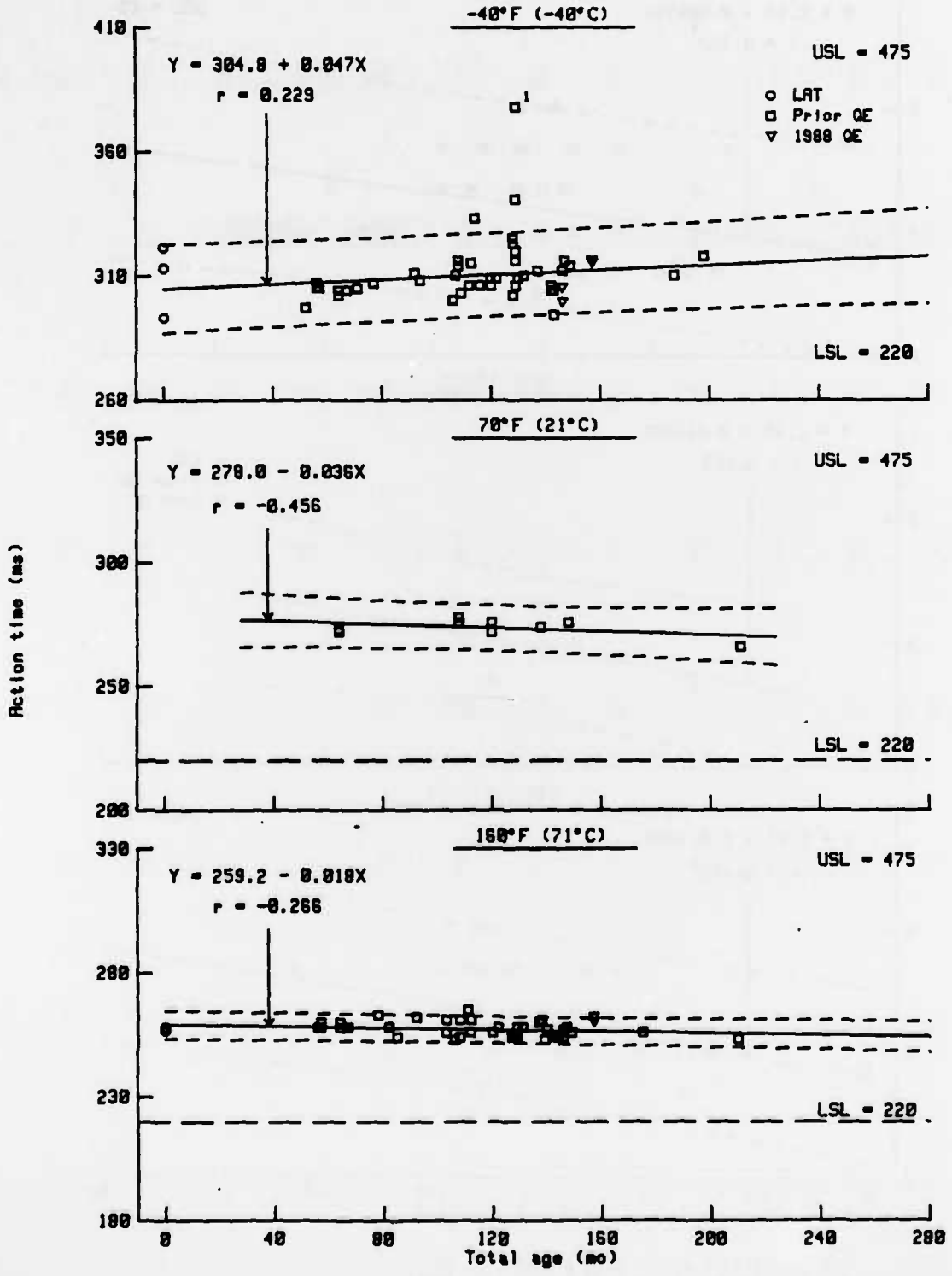
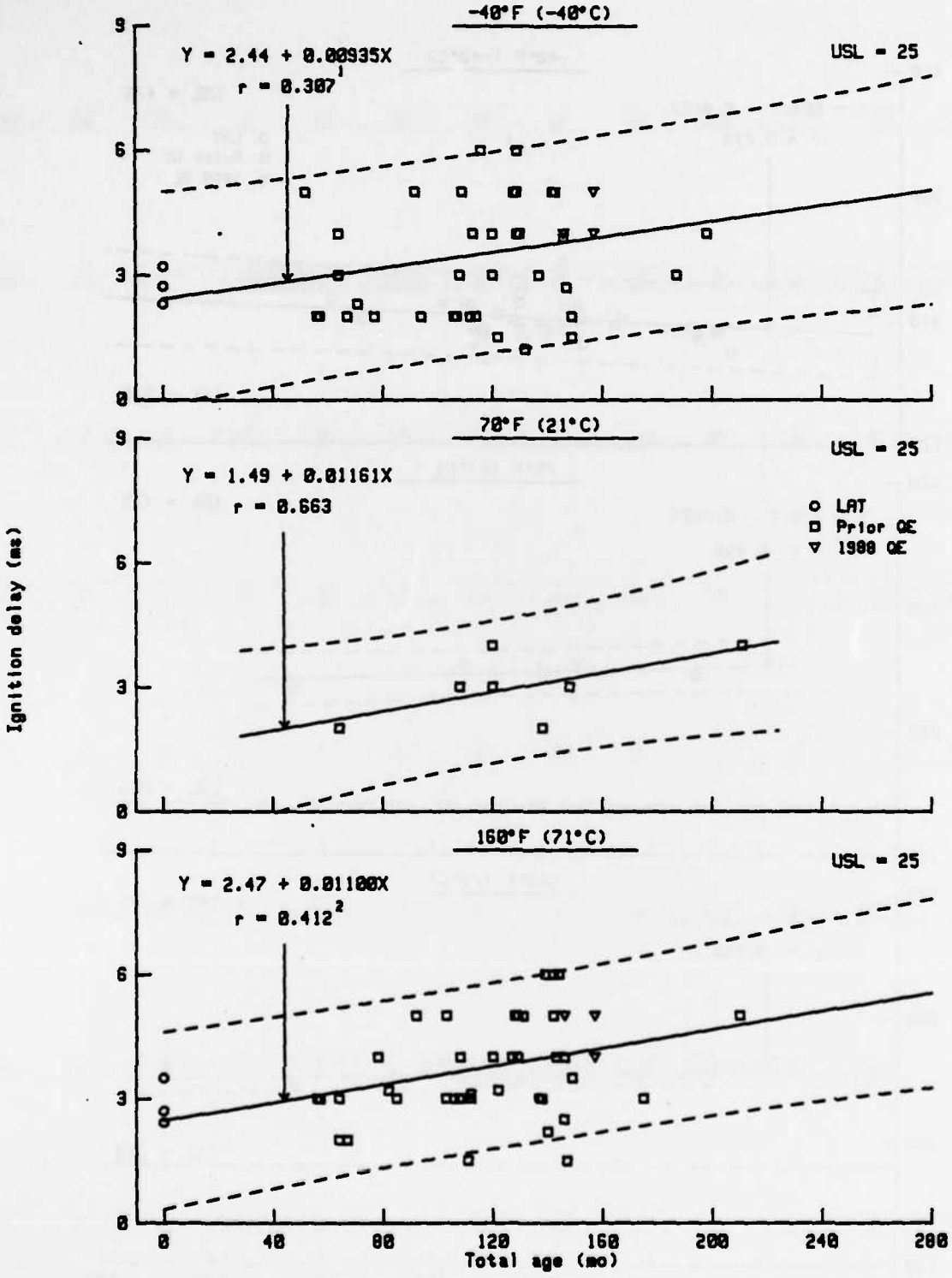


FIGURE C-2. IMPULSE VERSUS TOTAL AGE



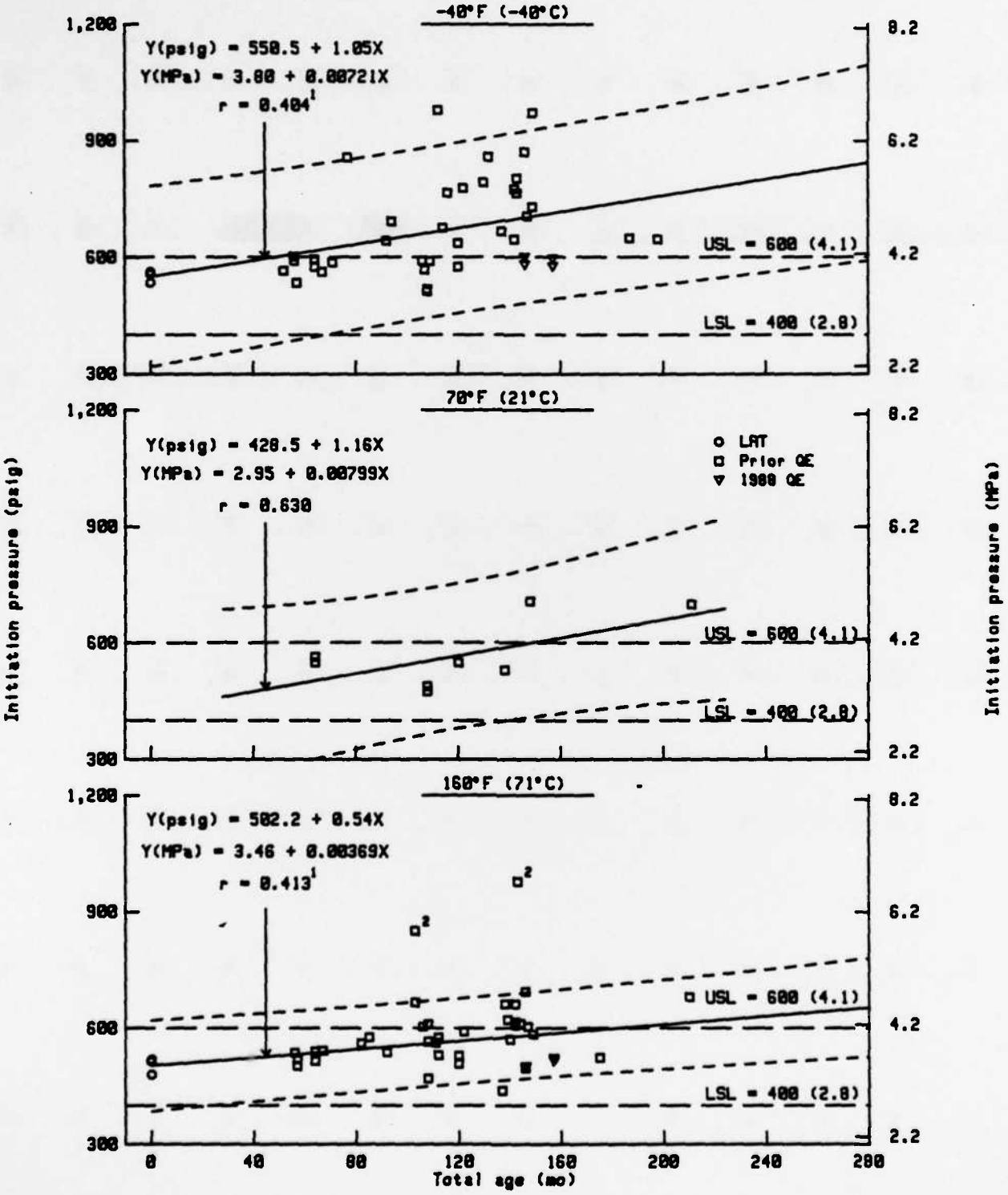
1 - Not used in regression analysis

FIGURE C-3. ACTION TIME VERSUS TOTAL AGE



1 - Significant at the 0.05 probability level
2 - Significant at the 0.01 probability level

FIGURE C-4. IGNITION DELAY VERSUS TOTAL AGE



1 - Significant at the 0.01 probability level
2 - Not used in regression analysis

FIGURE C-5. INITIATION PRESSURE VERSUS TOTAL AGE

DISTRIBUTION

Commander
Naval Air Systems Command
Attn: AIR-54041H
Washington, DC 20361-4200 1

Commander
Naval Air Systems Command
Attn: AIR-41831C
Washington, DC 20361-4200 1

Commander
Naval Air Systems Command
Attn: AIR-5132
Washington, DC 20361-4200 1

Administrator
Defense Technical Information Center
Attn: DDA
Cameron Station, Bldg. 5
Alexandria, VA 22314 2

Internal:

102	1
3820	3
3910	3
5110	1
5110L	1

END

DATE

FILMED

1-89

DTIC

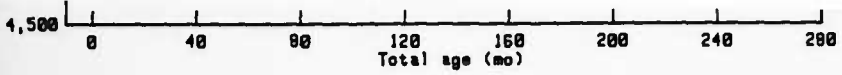


FIGURE C-1. MAXIMUM THRUST VERSUS TOTAL AGE

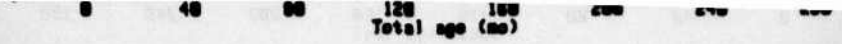


FIGURE C-2. IMPULSE VERSUS TOTAL AGE

1 - Not used in regression analysis

FIGURE C-3. ACTION TIME VERSUS TOTAL AGE